Ontario

Apprenticeship
In-school Curriculum Standards

Automotive Service Technician

Level 2

310S

Ministry of Training, Colleges and Universities

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AUTOMOTIVE SERVICE TECHNICIAN – LEVEL 2

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AUTOMOTIVE SERVICE TECHNICIAN – LEVEL 2

Introduction

This new curriculum standard for the Automotive Service Technician trade program is based upon the on-the-job performance objectives, located in the industry-approved training standard.

The curriculum is organized into 5 reportable subjects. The Program Summary of Reportable Subjects chart summarizes the training hours for each reportable subject.

The curriculum identifies only the learning that takes place off-the-job. The in-school program focuses primarily on the theoretical knowledge and the essential skills required supporting the performance objectives of the Apprenticeship Training Standards. Employers/Sponsors are expected to extend the apprentice's knowledge and skills through practical training on the work site. Regular evaluations of the apprentice's knowledge and skills are conducted throughout training to ensure that all apprentices have achieved the learning outcomes identified in the curriculum standard.

It is not the intent of the in-school curriculum to perfect on-the-job skills. The practical portion of the in-school program is used to reinforce theoretical knowledge. Skill training is provided on the job.

Automotive Service Technician

Level 2

AUTOMOTIVE SERVICE TECHNICIAN – LEVEL 2

Program Summary of Reportable Subjects - Level 2

Number	Reportable Subjects	Hours Total	Hours Theory	Hours Practical
1	Air Conditioning Systems	30	18	12
2	Engine Systems	36	22	14
3	Electrical / Electronic And Emissions Systems	96	64	32
4	Drive Train Systems	36	24	12
5	Suspension / Steering And Brake Systems	42	26	16
	Total	240	154	86

AUTOMOTIVE SERVICE TECHNICIAN – LEVEL 2

Number: **S1226**

Reportable Subject: **AIR CONDITIONING SYSTEMS**

Duration: Total 30 hours Theory 18 hours Practical 12 hours

Prerequisites: Level I, Reportables 1, 2, 3

1.1 Heating and Ventilation Systems

Total 4 hours Theory 2 hours Practical 2 hours

1.2 Air Conditioning Fundamentals

Total 22 hours Theory 12 hours Practical 10 hours

1.3 Repairers Rights and Responsibilities

Total 4 hours Theory 4 hours Practical 0 hours

Evaluation Structure

The following evaluation structure is only a suggested format. Specific evaluation of the theory and practical components of training will vary due to the institutional evaluation protocol, available resource material, training aides utilized and learning level of the individual student(s).

Evaluation should be broken down into two distinct areas; Theory Testing and Practical Application Exercises. The percentage between these two areas is directly related to the percentage of time that has been assigned for each Reportable subject.

Theory Testing	Practical Application Testing
70 %	30 %

AUTOMOTIVE SERVICE TECHNICIAN – LEVEL 2

1.1 Heating and Ventilation Systems

Duration: Total 4 hours Theory 2 hours Practical 2 hours

Cross Reference to Training Standards: 5172.01, 05

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to explain the functions and perform inspection, testing and diagnose heating and ventilation system according to manufacturers' recommendations.

LEARNING OUTCOMES AND CONTENT

1.1.1 Explain the fundamentals of heating and ventilation systems.

- air flow characteristics
- inside and outside ventilation
  - cabin pressure relief valve

1.1.2 Identify components of heating and ventilation systems.

- blower motors assemblies
- plenum assemblies
- air doors and controls
- heater cores
- heater control valves
- filter systems
- cabin pressure relief valve

1.1.3 Describe the principles of operation of heating and ventilation systems.

- ventilation systems
- blower assemblies
- plenum air flow
- air doors and controls
- heater cores
- heater control valves

AUTOMOTIVE SERVICE TECHNICIAN – LEVEL 2

1.1.4 Perform inspection, testing and diagnosis of heating and ventilation systems.

- inspect heater assemblies for
  - air leaks
  - coolant leak
  - door operation
  - blower operation
  - contamination
- diagnose heating and ventilation system for proper operation

AUTOMOTIVE SERVICE TECHNICIAN – LEVEL 2

1.2 Air Conditioning Systems

Duration: Total 22 hours Theory 12 hours Practical 10 hours

Cross Reference to Training Standards: 5172.01, 02, 03, 04

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to explain the functions and perform inspection, test and diagnose air conditioning system according to manufacturers' recommendations.

LEARNING OUTCOMES AND CONTENT

1.1.2 Explain the principles of air conditioning systems.

- methods of heat transfer
- temperature and humidity relationship
- solid, liquid and gas states
- gas laws, temperature, pressure and volume
- air conditioning thermo-dynamics
  - heat absorption
  - liquid and gas states
  - temperature effects
  - latent heat
  - ambient heat
- refrigerant waste law requirements

1.2.2 Identify the system types and components of air conditioning systems.

- TXV system components and location
- Orifice tube system components and location

1.2.3 Describe the operating principles of air conditioning systems and components.

- system lubrication
- control valves
  - low and high pressure cutout
- evaporator temperature controls
- condenser
- receiver dryer
- accumulator
- evaporator
- compressors

1.2.4 Describe refrigerants, lubricants and sealants.

- refrigerant characteristics
- alternative refrigerants
- lubricants
- sealants
- aftermarket chemicals

1.2.5 Describe air conditioning service procedures.

- diagnose
  - using gauges
  - using component temperatures
- recovery / recycle refrigerant and oil
- leak test
- evacuation
- recharge
- verify operation

1.2.6 Perform inspection, testing and diagnostic procedures.

- performance tests
- check system operating pressures and control functions
- diagnose system faults using pressure readings
- perform refrigerant recovery
- perform leak testing
  - dyes
  - electronic leak detectors
  - nitrogen testing

AUTOMOTIVE SERVICE TECHNICIAN – LEVEL 2

1.3 Repairers Rights and Responsibilities

Duration: Total 4 hours Theory 4 hours Practical 0 hours

Cross Reference to Training Standards: 5160.01, 02, 04

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will be aware of provincial statues and regulations pertaining to the automotive repair industry as required by law.

LEARNING OUTCOMES AND CONTENT

1.3.1 Describe Occupational Health and Safety Act (OHSA) and Workplace Hazardous Materials Information Safety (WHMIS)

- right to know
- safe handling of products
- hazardous materials
- obligations of employer and worker

1.3.2 Describe the Consumer Protection Act Part VI.

- responsibilities of the repairer
- obligations to the consumer

1.3.3 Describe the Repair and Storage Liens Act (RSLA)

- payment for repairs or storage
- liens
- seizure and sale
- dispute resolution procedures

1.3.4 Describe the Highway Traffic Act.

- obligations of repairers to report
- safety inspections (regulation 611)
- equipment
- unsafe vehicles
- detachment of components

1.3.5 Describe the Workplace Safety & Insurance Act.

- reporting accidents to company
- reporting accidents to WSIB
- required records
- training requirements
- accident prevention
- safety precautions
- first aid
- personal protection equipment
- house keeping

1.3.6 Describe the Employment Standards Act.

- hours of work
- overtime pay
- holidays
- vacations
- termination

1.3.7 Describe the Environmental Protection Act.

- liquid waste
- Ozone Depletion Prevention
- emissions

AUTOMOTIVE SERVICE TECHNICIAN – LEVEL 2

Number: **S1227**

Reportable Subject: **ENGINE SYSTEMS**

Duration: Total 36 hours Theory 22 hours Practical 14 hours

Prerequisites: Level I, Reportable 2

2.1 Valve Train and Camshaft

Total 12 hours Theory 8 hours Practical 4 hours

2.2 Cylinder Head Theory and Application

Total 18 hours Theory 10 hours Practical 8 hours

2.3 Turbochargers and Superchargers

Total 6 hours Theory 4 hours Practical 2 hours

Evaluation Structure

The following evaluation structure is only a suggested format. Specific evaluation of the theory and practical components of training will vary due to the institutional evaluation protocol, available resource material, training aides utilized and learning level of the individual student(s).

Evaluation should be broken down into two distinct areas; Theory Testing and Practical Application Exercises. The percentage between these two areas is directly related to the percentage of time that has been assigned for each Reportable subject.

Theory Testing	Practical Application Testing
70 %	30 %

AUTOMOTIVE SERVICE TECHNICIAN – LEVEL 2

2.1 Valve Train and Camshaft

Duration: Total 12 hours Theory 8 hours Practical 4 hours

Cross-Reference to Training Standards: 5161.01, 08, 09, 10

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to explain the operating characteristics, perform inspection and service of camshafts and valve train according to manufacturers' standards.

LEARNING OUTCOMES AND CONTENT

2.1.1 Explain the fundamentals of camshafts and valve train assemblies.

- camshafts
- valve timing
  - lead, lag, overlap, duration
  - valve train alignment
  - degreeing a camshaft
  - relationship of valves to piston position
  - interpret and draw valve timing diagram
- camshaft location and drive mechanisms
- valve train assemblies

2.1.2 Describe the characteristics and application of camshafts and valve train components.

- camshafts
- valve train mechanisms
- bearings, including split and bushing styles
- sprockets and gears
- thrust controls
- chains
- belts
- timing covers
- specific gaskets and seals

2.1.3 Explain the operating principles of valve train and camshaft components.

- camshafts
  - valve train drive mechanisms
  - chains
  - belts
- gears and sprockets
- bearings, including split and bushing styles
- thrust controls
- camshaft bearing removal and installation

2.1.4 Perform recommended inspection and testing procedures on camshafts and valve train components.

- visual inspection
- perform disassembly procedures
- check lobe wear
- check journal wear and thrust wear
- check camshaft warpage
- check bearing wear
- check timing chain, belt wear
- check tensioners, guides and idlers
- check lifters, rocker arms

2.1.5 Perform recommended service operations.

- remove and install timing belts and chains
- adjust timing chains and belts
- perform valve adjustment on a variety of styles

2.2 Cylinder Head Theory and Application

Duration: Total 18 hours Theory 10 hours Practical 8 hours

Cross-Reference to Training Standards: 5161.08, 09, 10

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to explain the service procedures, perform inspection, measurement and replacement procedures of engine cylinder heads and related components according to manufacturers' standards.

LEARNING OUTCOMES AND CONTENT

2.2.1 Define the fundamentals of engine cylinder heads and components.

- valves
- seats
- guides
- valve seals
- valve springs
- rocker arms and shafts
- push rods
- lifters, followers, lash controllers and variable valve actuators
- combustion chamber designs
- specific related gaskets

2.2.2 Explain the characteristics and applications of engine cylinder heads and components.

- valves
- seats
- guides
- valve seals
- valve springs
- rocker arms and shafts
- push rods
- lifters, followers, lash controllers and variable valve actuators
- combustion chamber designs
- specific related gaskets

2.2.3 Explain the recommended service procedures for engine cylinder heads and related components.

- cylinder head and intake manifold resurfacing
- cylinder head removal and disassembly procedures
- valve guide reaming, replacement, liner installation
- valve and valve seat interference angles
- valve seat width
- valve seal replacement
- valve spring inspection and installation
- valve retainers and rotators
- cylinder head installation procedures

2.2.4 Perform inspection and measuring procedures on engine cylinder heads and related components.

- disassembly procedures
- perform cleaning procedures
- visual inspection
- check for cracks
- check for cylinder head distortion
- check for valve guide wear
- check valve spring condition
- check valve condition
- check surface finish

2.2.5 Explain recommended service and reconditioning procedures on engine cylinder heads and related components.

- valve resurfacing
- seat cutting, grinding and replacing
- valve guides
- valve spring installation
- head re-surfacing
- verify valve to seat contact and sealing

2.3 Turbochargers and Superchargers

Duration: Total 6 hours Theory 4 hours Practical 2 hours

Cross-Reference to Training Standards: 5174.01, 05, 06, 07

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to explain the operation, perform inspection, diagnosis and replacement procedures of turbochargers, superchargers and related components according to manufacturers' standards.

LEARNING OUTCOMES AND CONTENT

2.3.1 Define the purpose and fundamentals of turbochargers and superchargers.

- relationship to
  - volumetric efficiency
  - air temperature
  - air flow rates
- electronic monitoring and controls

2.3.2 Describe the characteristics and application of turbochargers, superchargers and related components.

- turbochargers
  - housings, shaft, turbine, wheels, drive mechanisms, seals, bearings
  - intercoolers
  - controls
  - wastegate and exhaust system
  - exhaust thrust
  - electronic and mechanical
  - lubrication
  - oils, passages, lines
- cooling
  - cooling
  - liquid coolant, air flow
  - intercoolers
- superchargers
  - housings, drive mechanisms, shaft, rotors, bearings, seals
  - air flow

2.3.2 Continued

- controls
- power relief
- boost control
- electronic and mechanical

2.3.3 Explain the principles of operation of turbochargers and superchargers.

- turbochargers
  - boost pressures
  - wastegate
  - filtered air
  - exhaust gaskets
  - oil feed and pressure
  - exhaust pressures
- superchargers
  - low and high pressure
  - air flow
  - controls

2.3.4 Perform recommended service procedures on turbochargers and related components.

- inspect boost pressure and controls
- examine wastegate operation
- perform axial and radial runout checks
- measure end play
- inspect for air, oil, coolant and exhaust leaks
- verify oil supply and pressure
- research lubrication and cooling requirements
- clean air flow passages
- research replacement procedures
- research startup and shutdown procedures
- check for intercooler leaks and restrictions

2.3.5 Perform recommended service procedures on superchargers and related components.

- inspect boost pressure and controls
- perform clearance checks
- perform axial and radial runout checks
- measure rotor end play
- inspect for air, oil and coolant leaks
- research lubrication and cooling requirements

2.3.5 Continued

- clean air flow passages
- research replacement procedures
- research startup and shutdown
- check for intercooler leaks and restrictions

AUTOMOTIVE SERVICE TECHNICIAN – LEVEL 2

Number: **S1228**

Reportable Subject: **ELECTRICAL / ELECTRONICS AND EMISSIONS SYSTEMS**

Duration: Total 96 hours Theory 64 hours Practical 32 hours

Prerequisites: Level I, Reportable 3

3.1 Electrical Circuit Calculations

Total 6 hours Theory 4 hours Practical 2 hours

3.2 Diagnostic Test Equipment

Total 12 hours Theory 6 hours Practical 6 hours

3.3 Cranking Systems and Control Circuits

Total 12 hours Theory 8 hours Practical 4 hours

3.4 Cranking System Diagnostics and Testing

Total 8 hours Theory 4 hours Practical 4 hours

3.5 Electronic Fundamentals

Total 8 hours Theory 6 hours Practical 2 hours

3.6 Electronic Ignition Fundamentals

Total 16 hours Theory 12 hours Practical 4 hours

3.7 Charging Systems and Control Circuits

Total 14 hours Theory 10 hours Practical 4 hours

3.8 Gasoline Fuel Injection Fundamentals

Total 12 hours Theory 8 hours Practical 4 hours

AUTOMOTIVE SERVICE TECHNICIAN – LEVEL 2

3.9 Emission Control Systems

Total 8 hours Theory 6 hours Practical 2 hours

Evaluation Structure

The following evaluation structure is only a suggested format. Specific evaluation of the theory and practical components of training will vary due to the institutional evaluation protocol, available resource material, training aides utilized and learning level of the individual student(s).

Evaluation should be broken down into two distinct areas; Theory Testing and Practical Application Exercises. The percentage between these two areas is directly related to the percentage of time that has been assigned for each Reportable subject.

Theory Testing	Practical Application Testing
70 %	30 %

AUTOMOTIVE SERVICE TECHNICIAN – LEVEL 2

3.1 Electrical Circuit Calculations

Duration: Total 6 hours Theory 4 hours Practical 2 hours

Cross Reference to Training Standards: 5162.01, 5164.01, 02, 03, 04, 05, 06, 07

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to explain the characteristics of various circuit types and perform circuit calculations using a selection of meters according to accepted trade practices.

LEARNING OUTCOMES AND CONTENT

3.1.1 Explain the characteristics of electrical circuits.

- series circuits
- parallel circuits
- series – parallel circuits

3.1.2 Perform circuit calculations using Ohms' & Watts' Law.

- series circuits
- parallel circuits
- series – parallel circuits

3.1.3 Measure voltage, amperage and resistance.

- circuit board exercises
- simulated electrical circuits
- vehicle electrical circuits
- compare calculated and measured circuit performance

AUTOMOTIVE SERVICE TECHNICIAN – LEVEL 2

3.2 Diagnostic Test Equipment

Duration: Total 12 hours Theory 6 hours Practical 6 hours

Cross Reference to Training Standards: 5161.02, 04, 05, 06, 07, 08, 09

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to explain the purpose, principles of operation and usage of diagnostic test equipment according to the equipments manufacturers' recommendations.

LEARNING OUTCOMES AND CONTENT

3.2.1 Explain the purpose and principles of operation of diagnostic test equipment.

- pressure gauges
- vacuum gauges
- compression tester
- hand-held scan tools
- oscilloscopes
- smoke generators
- leak down tester
- pressure transducers

3.2.2 Perform diagnostic tests using the following equipment.

- pressure gauges
- vacuum gauges
- compression tester
- hand-held scan tools
- oscilloscopes
- smoke generators
- leak down tester
- pressure transducers

AUTOMOTIVE SERVICE TECHNICIAN – LEVEL 2

3.3 Cranking Systems and Control Circuits

Duration: Total 12 hours Theory 8 hours Practical 4 hours

Cross Reference to Training Standards: 5162.01, 02, 03

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to explain the purpose, construction and operating principles of cranking systems according to accepted manufacturers' standards.

LEARNING OUTCOMES AND CONTENT

3.3.1 Explain the purpose and fundamentals of cranking systems.

- cranking motors
- control circuits
- torque, load and cranking speed relationship

3.3.2 Explain the construction, types, styles and principles of operation of cranking motor circuits.

- starter control circuits
  - relay controlled cranking circuits
  - neutral switch
- starter solenoid
- cranking motors
  - gear reduction
  - permanent magnet field type
  - wire wound field type
- cranking motor drives

3.3.3 Disassemble and re-assemble cranking motors.

- inspect and test major components of cranking motors
  - armature for shorts, opens, ground, alignment
  - field coils for shorts, opens, ground
  - identify type of winding
  - pole shoes
  - bushings and bearings
  - brushes and springs

AUTOMOTIVE SERVICE TECHNICIAN – LEVEL 2

3.4 Cranking System Diagnostics and Testing

Duration Total 8 hours Theory 4 hours Practical 4 hours

Cross Reference to Training Standards: 5162.04, 05, 06

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to explain cranking system operations and perform diagnosis according to manufacturers' standards.

LEARNING OUTCOMES AND CONTENT

3.4.1 Explain the factors affecting engine cranking system performance.

- ambient temperature
- battery conditions and ratings
- engine mechanical loads
- charging system operation
- oxidation and corrosion of connections
- cable sizes and condition
- engine fuel and ignition system condition
- excessive cranking time and overheating

3.4.2 Perform inspection, testing, and diagnostic procedures on cranking motor circuits.

- Analyze the results.
  - cranking system visual inspection
  - battery load test and verify capacity and performance to application
  - cranking circuit voltage drop tests
  - cranking system current draw test
  - perform ring gear tooth inspection
  - slow cranking
  - no cranking

3.5 Electronic Fundamentals

Duration Total 8 hours Theory 6 hours Practical 2 hours

Cross Reference to Training Standards: 5162.01, 07, 5163.01, 02, 5164.01, 02

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to explain the construction, principles of operation, inspection and testing of electronic devices according to accepted trade practices.

LEARNING OUTCOMES AND CONTENT

3.5.1 Explain the construction, composition, types, principles of operation and applications of electronic devices.

- diodes
  - forward and reverse bias
  - current control
- transistors
  - switching
  - gain
- capacitors
- sensors
  - permanent magnet pulse generators
  - piezoelectric
  - galvanic
  - hall effect
  - optical
- variable resistors
  - rheostat
  - thermistors
  - potentiometers
  - piezoresistive

3.5.2 Perform inspection and testing procedures for electronic devices.

- diodes
  - forward and reverse bias
  - LED
  - rectifying / zener

3.5.2 Continued.

  - light emitting
  - photo
- capacitors
- sensors
  - permanent magnet pulse generators
  - piezoelectric
  - galvanic
  - hall effect
  - optical
- variable resistors
  - rheostat
  - thermistors
  - potentiometers
  - piezoresistive

3.6 Electronic Ignition Fundamentals

Duration Total 16 hours Theory 12 hours Practical 4 hours

Cross Reference to Training Standards: 5163.01, 05, 06, 07

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to explain the construction, principles of operation, inspection and testing of ignition systems according to manufacturers' standards.

LEARNING OUTCOMES AND CONTENT

3.6.1 Explain the purpose and fundamentals of electronic ignition systems and controls.

- electronic ignition systems
- computer-controlled timing
- distributorless ignition
- coil over plug
- factors that affect ignition timing
  - engine speed
  - engine load
  - engine temperature
  - input sensors

3.6.2 Explain the construction, types, styles, operation and application of electronic ignition systems devices.

- ignition coils
  - primary windings
  - secondary windings
- distributors
  - magnetic pulse generator
  - Hall Effect device
  - optical device
- secondary voltage circuit
  - high tension spark plug wires
  - spark plugs
  - distributor cap and rotor
- modules
- sensors

3.6.3 Inspect, test and diagnose electronic ignition systems devices.

- identify and locate electronic ignition system components on various vehicles
  - distributor components
  - coils, modules
  - sensors
- check and test ignition timing operation using a scan tool
- diagnose electronic ignition system components
  - high tension wires
  - spark plugs
  - distributor cap and rotor

3.7 Charging Systems and Control Circuits

Duration Total 14 hours Theory 10 hours Practical 4 hours

Cross Reference to Training Standards: 5162.01, 07, 08, 09

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to explain the construction, principles of operation, inspection and testing of charging systems according to manufacturers' standards.

LEARNING OUTCOMES AND CONTENT

3.7.1 Explain the purpose and fundamentals of charging systems and control circuits.

- alternators
- voltage regulation
- electromagnetic induction principles
- factors affecting alternator output
  - battery condition and temperature
  - circuit condition
  - engine speed
  - electrical loads

3.7.2 Explain the construction, types, principles of operation and application of charging systems and voltage regulations

- alternators
  - rectifier & diodes
  - stator
  - rotor
  - field winding, poles, slip rings
  - brush assemblies
  - bearings
  - pulleys
  - cooling fans
  - idlers and tensioners
- clutch pulleys / damper
- voltage regulator

3.7.3 Inspect, test and diagnose alternator and voltage regulation systems.

- perform charging system visual inspection
  - belt tension and alignment
  - connections and wiring
- perform charging system current and voltage output tests
- disassemble, test and re-assemble alternator
  - rotor field tests
  - rectifier diodes
  - stator

3.8 Gasoline Fuel Injection Fundamentals

Duration Total 12 hours Theory 8 hours Practical 4 hours

Cross Reference to Training Standards: 5165.01, 02, 03, 04

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to explain the purpose, construction, principles of operation, inspection and testing of electronic-controlled gasoline fuel injection systems according to manufacturers' standards.

LEARNING OUTCOMES AND CONTENT

3.8.1 Explain the purpose and fundamentals of gasoline fuel injection systems.

- port injection
- throttle body injection
- direct injection

3.8.2 Explain the construction, types, styles, operation and application of gasoline fuel injection and delivery systems.

- fuel tanks, lines and fittings
- filters and pumps
- injectors
- pressure regulators
- electronic control units
- returnless fuel systems

3.8.3 Inspect and test fuel injection systems.

- perform fuel pump tests
  - pressure
- visual inspection
  - leaks

AUTOMOTIVE SERVICE TECHNICIAN – LEVEL 2

3.9 Emission Control Systems

Duration Total 8 hours Theory 6 hours Practical 2 hours

Cross Reference to Training Standards: 5174.01, 08, 09, 10, 11, 12, 13

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to explain the purpose, construction, principles of operation, inspection and testing of emission control systems according to manufacturers' standards.

LEARNING OUTCOMES AND CONTENT

3.9.1 Explain the principles of operation of emission control systems.

- exhaust gas re-circulation systems
  - vacuum controlled
  - electronic controlled
- positive crankcase ventilation
- evaporative emissions systems
  - carbon canister
  - computer controlled fuel evaporative emission solenoids
- air injection systems
  - air pumps
  - air switching valves
- catalytic converters
  - three-way
- sensors / actuators

3.9.2 Inspect and test emission control systems.

- exhaust gas re-circulation systems
- positive crankcase ventilation
- evaporative emission systems
- air injection systems
- catalytic converters

AUTOMOTIVE SERVICE TECHNICIAN – LEVEL 2

Number: **S1229**

Reportable Subject: **DRIVE TRAIN SYSTEMS**

Duration: Total 36 hours . Theory 24 hours Practical 12 hours

Prerequisites: Level 1, Reportable 4

4.1 Drive Lines (FWD)

Total 3 hours Theory 3 hours Practical 0 hours

4.2 Drive Lines (RWD)

Total 3 hours Theory 3 hours Practical 0 hours

4.3 Final Drive Assemblies

Total 8 hours Theory 4 hours Practical 4 hours

4.4 Torque Converter Assembly

Total 3 hours Theory 3 hours Practical 0 hours

4.5 Automatic Transmission

Total 9 hours Theory 9 hours Practical 0 hours

4.6 Automatic Transmission Service Procedures

Total 10 hours Theory 2 hours Practical 8 hours

Evaluation Structure

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Evaluation should be broken down into two distinct areas; Theory Testing and Practical Application Exercises. The percentage between these two areas is directly related to the percentage of time that has been assigned for each Reportable subject.

Theory Testing	Practical Application Testing
70 %	30 %

AUTOMOTIVE SERVICE TECHNICIAN – LEVEL 2

4.1 Drive Lines (FWD)

Duration: Total 3 hours Theory3 hours Practical 0 hours

Cross-Reference to Training Standards: 5167.01, 02, 03, 04

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to perform visual inspection, diagnose, troubleshoot, repair front wheel drive axle assemblies according to manufacturers' standards.

LEARNING OUTCOMES AND CONTENT

4.1.1 Identify the specific components and describe the operation of front wheel drive axle assemblies.

- front wheel drive axles
  - half shafts
  - inner and outer constant velocity joints
  - joint types and boot retention
  - vibration damper
  - torque steer
  - bearings and supports

4.1.2 Perform inspection, diagnosis, troubleshooting, and service on front wheel drive axle assemblies.

- visual inspection
- symptom diagnosis / noise and vibration
- removal and installation constant velocity (CV) shaft
- repair constant velocity (CV) shaft
  - component inspection
  - joint replacement
  - boot service
  - lubrication

4.2 Drive Lines (RWD)

Duration: Total 3 hours Theory 3 hours Practical 0 hours

Cross-Reference to Training Standards: 5167.01, 02, 03, 04

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to perform visual inspection, diagnose, troubleshoot, repair rear wheel drive drivelines according to manufacturers' standards.

LEARNING OUTCOMES AND CONTENT

4.2.1 Explain the basic fundamentals of driveline (RWD) systems.

- angular movement
- linear movement
- centrifugal force
- relationship of drive shaft speed and balance
- phasing and working angles

4.2.2 Identify the specific components and describe the operation of rear wheel drivelines.

- rear wheel drive shaft assemblies
  - single, multiple
  - steel, aluminum, and composite
  - joint types
  - constant velocity
  - slip yoke and flanges
  - bearings and supports
  - vibration damper

4.2.3 Perform inspection, diagnosis, troubleshooting, and service on rear wheel drivelines.

- visual inspection
- symptom diagnosis / noise and vibration
- measurements
  - runout
  - phasing
  - working angles

4.2.3 Continued

- shaft removal and installation procedures
- shaft repair
  - component inspection
  - joint replacement
  - indexing
  - boot service
  - lubrication

4.3 Final Drive Assemblies

Duration: Total 8 hours Theory 4 hours Practical 4 hours

Cross-Reference to Training Standards: 5167.01, 02, 03, 04

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to perform visual inspection, diagnose, troubleshoot, repair final drive assemblies according to manufacturers' standards.

LEARNING OUTCOMES AND CONTENT

4.3.1 Identify the specific components and describe the operation of final drive assemblies.

- hotchkiss
- torque tube
- housing types
  - banjo
  - independent
- carrier types
  - integral, removable
- gear types
  - spur bevel, spiral bevel, helical, hypoid, planetary
- gear set / ratio
  - hunting, non-hunting, partial non-hunting
- pinion mounting
  - straddle, overhung
- axle types
  - full floating, ¾ floating, semi-floating
- differential types
  - open, limited slip, locking, air, hydraulic, electronic, viscous, planetary
- front and rear axle controls
- bearings, seals, and gaskets
- lubricating oils

4.3.2 Perform inspection, diagnosis, troubleshooting, and service on final drive assemblies.

- visual inspection
- symptom diagnosis / noise and vibration
- check unit bearing preload
- check pinion bearing preload
- check differential case side bearing preload
- measure backlash
- measure ring gear runout
- determine tooth contact
  - patterns and corrections
- perform adjustments
  - pinion depth
  - pinion preload
  - backlash and side bearing preload
  - patterns and corrections
- perform axle shaft service procedures
  - retention, bearings and seals
- perform differential service procedures
  - open and limited slip

4.4 Torque Converter Assembly

Duration: Total 3 hours Theory 3 hours Practical 0 hours

Cross-Reference to Training Standards: 5166.01

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to perform visual inspection, diagnose, troubleshoot, repair automatic transmission torque converter according to manufacturers' standards.

LEARNING OUTCOMES AND CONTENT

4.4.1 Explain the basic fundamentals of fluid couplers and torque converters.

- centrifugal force
- torque transmission
- torque multiplication

4.4.2 Identify the specific torque converter components

- impeller
- turbine
- stator, one way clutch
- split guide rings
- vane pitch
- fixed vane
- variable vane
- piston lockup clutch
  - pressure plate, friction material, dampener
  - clutch controls, hydraulically, electronically
- shafts
  - turbine
  - direct drive shaft
  - stator
  - pump drive

4.4.3 Describe the operation of torque converters.

- flow characteristics
  - vortex, rotary, and centrifugal force

4.4.3 Continued.

- impeller
- turbine
- stator / multi stator
- pitch
- fixed vane
- variable vane
- operational phases
  - stall phase
  - torque multiplication phase
  - coupling phase
  - lock-up phase

4.4.4 Perform inspection, diagnosis, troubleshooting, and service on torque converters and controls.

- perform unit inspection
  - leaks
  - contamination
  - endplay
  - drive surface
  - seal surface
- perform functional / performance test
- check for noise and vibration
- verify torque converter lockup and release operation

AUTOMOTIVE SERVICE TECHNICIAN – LEVEL 2

4.5 Automatic Transmission / Transaxle

Duration: Total 9 hours Theory 9 hours Practical 0 hours

Cross-Reference to Training Standards: 5166.01

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to describe the operation of automatic transmissions / transaxles according to manufacturers' standards.

LEARNING OUTCOMES AND CONTENT

4.5.1 Explain the basic fundamentals of automatic transmissions / transaxles.

- Pascals Law
- basic hydraulics
  - force, area, pressure
  - hydraulic mechanical advantage
  - valve purpose: control, regulation, balanced, differential force.
- simple planetary gear operation

4.5.2 Identify the specific components and describe the basic operation of automatic transmissions / transaxles.

- pumps
  - positive displacement
    - internal / external
    - gearotor
    - vane
- variable displacement
- control system / valve body
  - mainline or control pressure regulator
  - manual, throttle, governor, shift, and modulator valves
  - converter control valves
  - limit valves
- apply devices
  - material types
  - bands
  - single / double wrap
  - flex / rigid
- multiple disc clutches

4.5.2 Continued

- one-way clutches
  - sprag
  - roller
  - mechanical diode
- gear sets and power flow
  - Simpson
  - Ravineaux
  - tandem compound
- parking mechanism
  - park pawl and park gear
- transmission / transaxle case passages and fluid circuits
  - filters
  - orifices, check balls
  - accumulators
  - pistons and servos
- cooling / lubrication system
  - heat exchanger
  - lines
  - auxiliary cooling systems
  - air cooled systems

AUTOMOTIVE SERVICE TECHNICIAN – LEVEL 2

4.6 Automatic Transmission / Transaxle Service Procedures

Duration: Total 10 hours Theory 2 hours Practical 8 hours

Cross-Reference to Training Standards: 5166.01, 02

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to perform visual inspection, diagnose, troubleshoot, repair automatic transmission / transaxles according to manufacturers' standards.

LEARNING OUTCOMES AND CONTENT

4.6.1 Perform inspection, testing, and diagnosis procedures on automatic transmissions / transaxles.

- visual inspection
- fluid level checks
- road test procedures
- linkage adjustments
- hydraulic pressure testing
- power flow analysis
- noise and vibration
- identify component failures and causes

4.6.2 Perform service and repair procedures.

- determine disassembly sequence
- note cautions
- check for required end play
- air test
- identify and locate special tools
- disassemble transmission / transaxle
- identify components
- layout parts in order removed
- trace power flow through unit
- disassemble and inspect sub components
- perform required measurements
- locate selective washers
- locate thrust washers
- reassemble and test

AUTOMOTIVE SERVICE TECHNICIAN – LEVEL 2

Number: **S1230**

Reportable Subject: **SUSPENSION / STEERING AND BRAKE SYSTEMS**

Duration: Total 42 hours Theory 26 hours Practical16 hours

Prerequisites: Level I, Reportable 1, 3, 5

5.1 Suspension System Fundamentals and Servicing

Total 9 hours Theory 4 hours Practical 5 hours

5.2 Manual and Power Assisted Steering Systems

Total 9 hours Theory 6 hours Practical 3 hours

5.3 Alignment Fundamentals

Total 9 hours Theory 9 hours Practical 0 hours

5.4 Alignment Equipment

Total 3 hours Theory 1 hour Practical 2 hours

5.5 Hydraulic Brake Servicing

Total 12 hours Theory 6 hours Practical 6 hours

Evaluation Structure

The following evaluation structure is only a suggested format. Specific evaluation of the theory and practical components of training will vary due to the institutional evaluation protocol, available resource material, training aides utilized and learning level of the individual student(s).

Evaluation should be broken down into two distinct areas; Theory Testing and Practical Application Exercises. The percentage between these two areas is directly related to the percentage of time that has been assigned for each Reportable subject.

Theory Testing	Practical Application Testing
70 %	30 %

AUTOMOTIVE SERVICE TECHNICIAN – LEVEL 2

5.1 Suspension System Fundamentals and Servicing

Duration: Total 9 hours Theory 4 hours Practical 5 hours

Cross-Reference to Training Standards: 5168.01, 03, 04

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to inspect, test and service suspension and steering systems in accordance with manufacturers' recommendations.

LEARNING OUTCOMES AND CONTENT

5.1.1 Explain the operation, servicing and inspection of the following suspension and steering components.

- strut assemblies
- wheel hubs
- wheel bearings
  - adjusting
  - packing
- chassis lubrication
- shock absorbers / dampeners
- adjustable shock absorbers / dampeners
  - mechanical
  - electronic
- ball joints
  - movement – axial and radial
  - wear indicating
- steering linkage
  - movement – axial and radial

5.1.2 Perform removal and installation of the following suspension and steering components.

- strut assemblies
- wheel hubs
- wheel bearings

5.1.3 Inspect, test and service the following suspension and steering components.

- inspect strut assemblies
- inspect wheel hubs
- adjust and pack wheel bearings
- check ball joints
  - movement – axial and radial
  - wear indicating
- check steering linkage
  - movement– axial and radial

AUTOMOTIVE SERVICE TECHNICIAN – LEVEL 2

5.2 Manual and Power Assisted Steering Systems

Duration: Total 9 hours Theory 6 hours Practical 3 hours

Cross-Reference to Training Standards: 5169.01, 02, 03, 04

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to identify and explain the construction and operation of steering gear system including inspection and testing procedures in accordance with manufacturers' recommendations.

LEARNING OUTCOMES AND CONTENT

5.2.1 Identify and explain the following steering components.

- manual steering gears
- power steering
- power steering pumps
- power steering valves
- fluids
- lines, fittings, hoses
- coolers
- electronic power steering

5.2.2 Explain the operation of manual and power- assisted steering systems.

- manual steering gears
- power steering gears
  - recirculating ball
  - rack and pinion
- power steering
  - recirculating ball
  - rack and pinion
- power steering pumps
  - gear
  - vane
  - slipper
  - roller
- power steering valves
  - directional control
  - flow control
  - pressure relief

5.2.2 Continued

- fluids
- lines, fittings, hoses
- coolers
- electronic power assist
- four wheel steer

5.2.3 Inspect, test and service power steering pumps and power steering units.

- test manual steering gears
  - proper operation
  - proper adjustment
  - leaks
- test power steering gears
  - proper operation
  - proper adjustment
  - leaks
- test power steering pumps
  - proper operation
  - leaks
  - drive adjustment
- check power steering valves
  - operation
  - leakage internal / external
- inspect fluids
  - cleanliness
  - proper levels
- inspect lines, fittings, hoses
  - leaks
  - fatigue
- inspect coolers
  - leaks
  - air flow

5.2.4 Perform assigned operations.

- dismantling, inspecting, re-assembling and adjusting of power steering
  - gears
  - pumps
- check and adjust drive belt tension
- steering linkage lubrication

5.3 Alignment Fundamentals

Duration: Total 9 hours Theory 9 hours Practical 0 hours

Cross-Reference to Training Standards: 5169.01, 02, 03, 04

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to define, explain and calculate wheel alignment angle adjustments according to manufacturers' recommendations.

LEARNING OUTCOMES AND CONTENT

5.3.1 Define alignment angles and measurements.

- caster
- camber
- toe-in / toe-out
- steering axis inclination
- turning radius
- trim height
- thrust line
- thrust angle
- geometric centre line
- Ackerman's principles
- Included angle
- set back
- scrub radius

5.3.2 Identify alignment types and adjustment styles.

- types of alignment
  - two-wheel geometric center line alignment
  - two-wheel thrust line alignment
  - four-wheel alignment
- eccentrics
- shims / contact shims
- slots
- strut rods
- wedges
- elongating holes

5.3.3 Explain the following wheel alignment adjustments and calculations.

- eccentrics
- shims
- contact shims
- slots
- strut rods
- wedges
- elongating holes

5.4 Alignment Equipment

Duration: Total 3 hours Theory 1 hour Practical 2 hours

Cross-Reference to Training Standards: 5169.03, 04

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to operate wheel alignment equipment in accordance with the manufacturers' recommendations.

LEARNING OUTCOMES AND CONTENT

5.4.1 Explain the operation of vehicle alignment equipment.

- demonstration of
  - operating procedures of alignment equipment
  - calibration of equipment
  - vehicle setup

5.4.2 Measure four wheel alignment angles.

- set up alignment equipment
- measure and record alignment angles

AUTOMOTIVE SERVICE TECHNICIAN – LEVEL 2

5.5 Hydraulic Brake Servicing

Duration: Total 12 hours Theory 6 hours Practical 6 hours

Cross-Reference to Training Standards: 5170.01, 02, 03, 04

GENERAL LEARNING OUTCOMESS

Upon successful completion the apprentice will have the ability to inspect, diagnose disc and drum brake systems according to manufacturers' recommendations.

LEARNING OUTCOMES AND CONTENT

5.5.1 Explain inspection, testing and diagnostic procedures of brake system components in accordance with the manufacturers' recommendations.

- lines
  - flex
  - steel
- disc brakes
  - rotor thickness / runout / parallelism / condition
  - lining thickness / condition
  - resurfacing
- drums brakes
- diameter/out of round / condition
  - lining thickness / condition
  - resurfacing
- brake hydraulic system pressure tests
- brake system operational tests
  - in shop
  - road test

5.5.2 Perform assigned operations for drum and disc brakes.

- removal and installation procedures for drums, discs, pads and shoes
- adjustment and cleaning procedures for drum and disc brake assemblies
- perform drums brake
  - measure diameter / out of round / condition
  - measure lining thickness / condition
  - resurface drums

5.5.2 Continued

- perform disc brake
  - measure rotor thickness / runout / parallelism / condition
  - measure lining thickness / condition
  - resurface rotor
- interpret test results and performance problems
  - noises
  - drag or lockup
  - vibrations
  - imbalance
- perform brake system tests
  - hydraulic pressure test
  - performance tests